View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Louisiana State University

Louisiana State University
LSU Digital Commons

LSU Agricultural Experiment Station Reports | LSU AgCenter

1935

Blackstrap molasses and corn-soybean silage for fattening steers

Maynard Goldman Snell

Follow this and additional works at: http://digitalcommons.lsu.edu/agexp

Recommended Citation

Snell, Maynard Goldman, "Blackstrap molasses and corn-soybean silage for fattening steers" (1935). *LSU Agricultural Experiment Station Reports*. 551.
http://digitalcommons.lsu.edu/agexp/551

This Article is brought to you for free and open access by the LSU AgCenter at LSU Digital Commons. It has been accepted for inclusion in LSU Agricultural Experiment Station Reports by an authorized administrator of LSU Digital Commons. For more information, please contact gcoste1@lsu.edu.

-66 .E56
Library, New Mexico State College

JULY, 1935 LOUISIANA BULLETIN No. 266

Blackstrap Molasses and Corn-Soybean Silage for Fattening Steers

By
M. G. SNELL

SURPLUS
Worn Out
Obsolete
Unbindable
Duplicated
NMSU LIBRARY
LAS CRUCES

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS

C. T. DOWELL
Director

SUMMARY

PART I

The addition of molasses to dry rations—that is, to rations not containing silage—had no significant effect upon the digestibility of crude protein, ether extract, or crude fiber. The nitrogen-free extract and the ash digestibility were increased significantly, except in the case of nitrogen-free extract in trial V, 1930-31, which was lowered. These increases were probably due to the molasses adding N. F. E. (sugars) and ash in a highly digestible form and not to any effect on the digestibility of the N. F. E. and ash of the other ingredients of the ration. The decreased digestibility of N. F. E. in trial V, 1930-31, was probably due to an excess of sugars, as this ration contained 57.81 per cent molasses. Adding molasses to a dry ration did not affect significantly the nitrogen balances of those rations.

Adding molasses to a dry ration did, however, increase the ash calcium, and magnesium balances but did not affect the phosphorous balance. The figures presented in the balance tables are indicative of a low ash and calcium intake in the basal rations.

Adding silage to the dry ration had no significant effect upon the digestibility of the nutrients except to lower the digestibility of ash.

Addition of molasses to a silage ration lowered the digestibility of crude protein but increased the digestibility of the ether extract and ash.

Addition of molasses to a silage ration lowered the nitrogen balance, indicating a lowered utilization of nitrogen or protein.

PART II

1. Satisfactory gains were made with rations of ground whole ear corn, cottonseed meal, and grass hay.

2. The addition of corn-soybean silage to a ration of ground whole ear corn, cottonseed meal, and grass hay increased the gains one year and decreased them the following year. The corn-soybean silage used the second year was of poor quality, which may account for its poor results.

3. The addition of molasses to both rations; i. e., ground whole ear corn, cottonseed meal, and hay or ground whole ear corn, cottonseed meal, hay, and silage, resulted in an increased consumption of hay and better cleaning of the feed, showing that molasses stimulated the appetite.

4. From a monetary standpoint, molasses when fed in a dry ration had about 94 per cent the value of ground whole ear corn; when fed in a ration with silage, it had about 87 per cent the value of ground whole ear corn.

BLACKSTRAP MOLASSES AND CORN-SOYBEAN SILAGE FOR FATTENING STEERS

M. G. SNELL

INTRODUCTION

Cane molasses or "blackstrap" is one of the by-products of the sugarcane industry. It is the low grade sirup from which most of the crystallizable sugar has been removed. Much of the mineral matter, resins, etc., are concentrated in this residue in the extraction of sugar. Louisiana alone produces about 11,621,000 gallons, or 67,982 tons annually, much of which is available for livestock feeding. The above figures are a five-year average blackstrap production for Louisiana for the years 1929 to 1933 inclusive.

The feeding of cane molasses or blackstrap to livestock in Louisiana is probably as old as the sugarcane industry in the state. Molasses has been fed to livestock, chiefly for fattening cattle, at various agricultural experiment stations in recent years, but as yet information as to its most economical use is lacking. Many stations have obtained conflicting results when molasses has been used in the ration, having secured good results with some rations and poor results with others.

The Louisiana Agricultural Experiment Station started an experiment in the fall of 1929, the object of which was to get additional information on molasses as a feed for fattening cattle. This project had two major parts; i.e., the study of (1) the effect of molasses upon the digestibility of cattle rations, and (2) the effect of including molasses in the ration of fattening steers upon their rates of gain.

REVIEW OF LITERATURE

Henry and Morrison (1922) state that "blackstrap" molasses, when fed in moderate amounts, is about equal to corn, pound for pound, for horses, dairy cattle, sheep, and fattening steers. According to these authors, molasses should not furnish more than one-half of the total concentrates fed in a beef ration. They say that it is only mildly laxative and seems to exert a healthful effect on the animal, but that is should be fed in a well-balanced ration. Thinning the molasses with water and pouring it over hay or silage is indicated as the preferred method of feeding.

Burns, of the Texas Experiment Station, as reported by Henry and Morrison (1922), fed molasses to 2-year-old steers for a period of 120 days. Six and one-half pounds of molasses replaced with good results a similar amount of corn when the basal ration was composed of shelled corn, cottonseed meal, and cottonseed hulls. The molasses-fed steers made slightly greater gains and required less feed per 100 pounds gain.

McCampbell and Winchester (1920), of the Kansas Experiment Station, found cane molasses to compare favorably in feeding value with corn for steer feeding when substituted for shelled corn in a ration of shelled corn (limited), linseed oil meal, cane silage, and alfalfa hay. The average amount fed in this case was 2.07 pounds per steer daily.

Trowbridge (1924), of the Missouri Station, found the addition of one pound of cane molasses to a ration of shelled corn, linseed oil meal, corn silage, and alfalfa hay fed to 2-year-old steers resulted in increased gains. In this case, 100 pounds of molasses were equivalent to 46.9 pounds of shelled corn, 9.4 pounds of linseed oil meal, 6.3 pounds of alfalfa hay, and 175 pounds of silage.

Templeton and Goodell (1927) report four years' results of molasses feeding to yearling and 2-year-old steers. The basal ration was cottonseed meal, silage, and Johnson grass hay. In addition, one lot received an average of 2.57 pounds of molasses daily per steer, and another lot 5.15 pounds daily per steer. In the "light" molasses group, 100 pounds of molasses were equivalent to 13.2 pounds of cottonseed meal, 197.1 pounds silage, and 8.5 pounds hay. In the "medium" molasses ration, 100 pounds of "blackstrap" were equivalent to 9.6 pounds of cottonseed meal, 144.9 pounds silage, and 10.6 pounds of hay. The results are the most consistent, one year with another, that the author has reviewed. It may be that molasses is particularly adapted to this type of ration.

Quesenberry (1929), of the Iberia Livestock Experiment Farm (U. S.), Jeanerette, Louisiana (1925), found that the addition of 2.86 pounds of molasses daily to a ration of corn silage, and cottonseed meal fed to 2 year old steers resulted in increased daily gains, but at an increase in the feed required for a 100 pound gain. This same station (1926-27) the following two years found that the addition of two pounds of molasses to a ration of corn, soybean silage, and cottonseed meal decreased the daily gains and increased the feed required to produce a 100 pound gain. In other words, blackstrap had a negative feeding value.

Evvard and Culbertson (1921) added cane molasses at the rate of one, three, and five pounds per head daily to the rations of 2-year-old steers, the basal ration being shelled corn linseed oil meal, corn silage, and clover hay. In this test 100 pounds of molasses had a feeding value equivalent to 244, 106, and 123 pounds of corn, respectively, for the three lots. The following year a duplicate test was run, but in each case the value of cane molasses was less than that of shelled corn, pound for pound.

Culbertson et al (1929) reported two years' work on molasses for fattening calves. In the 1926-27 trial two lots of calves averaging 436 pounds per lot received shelled corn, linseed oil meal, alfalfa hay, and salt for 150 days. For the next 120 days one lot received approximately one pound of cane molasses per steer daily. The

molasses-fed steers ate practically as much corn and linseed oil meal as the other group, and the molasses in addition, but gained less. Roughly, 100 pounds of molasses and 31.5 pounds of corn were equivalent to 63.2 pounds of alfalfa hay. The following year, 1927-28, two lots of calves averaging 381 pounds per lot were fed shelled corn, linseed oil meal, corn silage, a mineral mixture, and block salt for 150 days. During the next 90 days, one lot of calves had access to molasses in a self-feeder. The average daily gain of the two lots was practically the same, being 2.31 and 2.33, respectively, for the check and molasses-fed lot. Again the molasses-fed group ate almost as much as the check lot. In this case, 100 pounds of molasses were equivalent to approximately 25.8 pounds of corn.

Templeton (1925) fed "blackstrap" to hogs for a period of 98 days: the first 30 days in dry lot, and the remainder of the period on pasture. In this test 100 pounds of molasses were equivalent to 8.0 pounds of corn and 12.2 pounds of tankage.

Nelson, Keller, and Fulmer (1925) found cane molasses to be an excellent source of vitamin B. Their work also indicates the presence of a reproductive vitamin.

Williams (1925) tested the effect of cane molasses on the digestibility of complete ration when fed to dairy cows. Three experiments of three digestion trials, or a total of nine digestion trials, on each of four Holstein cows were run. The basal ration consisted of corn meal, wheat bran, ground oats, linseed oil meal, peanut meal, gluten meal, hay, silage, and salt. In the second trial, 15 per cent, and in the third trial 25 per cent cane molasses was added to the basal mixture. The effect was a slight lowering of the digestibility of the crude protein. The digestibility of the dry matter, ether extract, crude fiber, and nitrogen free extract seemed unaffected.

Skinner and King (1916) found that the addition of molasses to a ration of shelled corn, cottonseed meal, clover hay, and corn silage for lambs resulted in an increased daily gain, with less feed required per 100 pound gain.

Evvard, Culbertson, and Wallace (1923) in a lamb feeding trial compared a ration of shelled corn, full-fed, linseed oil meal 0.15 pounds daily, corn silage 1.504 daily, and legume hay 0.180 pounds daily with similar rations but received approximately 0.25 pounds, 0.50 pounds, and 0.75 pounds molasses daily. They conclude from this work that for fattening lambs molasses has a feeding value of from 10 to 15 per cent less than shelled corn.

Sheets (1928) states that satisfactory results have not been obtained in a number of experiments and suggests the possibility that these poor results may be due to factors other than the combination of feeds or the amount of molasses fed. He suggests the value of chemical analysis in helping to solve this problem.

Tomhave and Severson found molasses to have a lower feeding value than corn when fed at the rate of 5 pounds per head daily to steers receiving corn, mixed hay, corn silage, and cottonseed meal. However, Tomhave, Mackenzie, and Bentley found molasses to be worth more than corn when fed at the rate of 3.7 pounds to steers on a similar ration.*

Dalrymple (1906) found on collecting data from 47 Louisiana plantations that an average of 9.5 pounds of cane molasses was fed daily to work mules.

Brintnall (1921) replaced corn grain with molasses, pound for pound, in the ration of dairy cows and found the molasses fully equivalent to corn grain in the production of milk and butterfat and in the maintenance of body weight. The same author, in working with dairy calves, found molasses to be equal to corn as a feed for growing dairy calves. In this work, from two to five pounds of molasses were fed to each cow daily, and one pound of molasses was given each day to the calves, the molasses being mixed with other feeds.

Gerlaugh (1930) found that: (1) Blackstrap molasses has an appetizing effect, causing an increased consumption of feed; (2) blackstrap molasses contains a factor which stimulates growth; (3) two pounds of blackstrap have a feeding value equivalent to approximately two pounds of shelled corn when fed to fattening calves so as to replace an equivalent amount of shelled corn in the ration; (4) when fed at the rate of two and four pounds per calf daily, calves would consume these amounts in addition to their corn, and make only slightly more gain than calves on shelled corn; (5) four pounds of molasses when fed in addition to shelled corn produced only slightly greater gains than two pounds of molasses, showing that as the amount of molasses in the feed increased, the feeding value of the molasses decreased.

Snell and Taggart (1932) found blackstrap molasses (1) to be equivalent to corn grain as a feed for farm work mules and (2) to increase the appetite of farm work mules.

Peters (1933) reports work with fattening steers in dry lot when blackstrap molasses was used as a part of the grain ration. In the first of these trials, 2.5 pounds of molasses were not equivalent to 1.5 pounds of linseed meal when fed with corn and alfalfa hay. When fed with corn, linseed meal, and alfalfa, molasses had almost a negative feeding value. A daily consumption of 2.53 pounds of molasses in addition to the other feeds decreased gains. Self-feeding molasses resulted in a daily consumption of 436 pounds of molasses and an increase in daily gain. In the second year's results, two pounds of molasses were fed so as to replace two pounds of shelled corn, but proved to have a lower feeding value than shelled corn.

*Reported by Henry and Morrison—"Feeds and Feeding". Page 479.

Bohstedt (1933) reports feeding trials with dairy cows, fattening steers, fattening lambs, and growing fattening pigs, in which cane molasses replaced 10 per cent of corn in the grain mixture. In all cases except one (self-fed lambs), the rations containing molasses required more feed to produce 100 pounds of gain than did the rations containing no molasses. Molasses was worth less then shelled corn.

Calloway (1921) fed as much as two pounds of molasses, together with skim milk and grain mixture, to young dairy calves and obtained good results.

For a period of 112 days Edwards and Massey (1934) fed three lots of steers averaging about 600 pounds. Lot I received a full feed of shelled corn; lot II had one-fourth of its shelled corn (3.31 pounds) replaced by an equal amount of molasses; lot III had one-half of its shelled corn (6.62 pounds) replaced by an equal amount of molasses. Each lot received 2.50 pounds of cottonseed meal, 6 pounds of cottonseed hulls, and 0.12 pounds of mineral mixture for each steer daily. The average daily gains were: lot I, 2.36 pounds; lot II, 2.28 pounds; and lot III, 1.99 pounds. In producing gains, 100 pounds of shelled corn were equivalent to 114 pounds of molasses, 2.7 pounds of cottonseed meal, and 6.6 pounds of hulls in lot II, or 136 pounds of molasses, 6.8 pounds of cottonseed meal, and 16.4 pounds of hulls in lot III. From these figures, it is seen that molasses when fed as in lot II has a feeding value somewhat less than 88 per cent of corn, and as fed in lot III, less than 74 per cent of shelled corn.

Neale (1932) found cane molasses to increase the rate of gain, eliminate death losses, and to increase the general health and appearance of lambs getting cottonseed meal and cottonseed hulls.

Lantow (1933) found cane molasses to be palatable and to increase the consumption of feed when added to the ration of fattening steers.

PART I

DIGESTION TRIALS WITH MOLASSES

1929-30 RESULTS

Inasmuch as the review of literature showed quite variable results with molasses, it was thought that molasses might affect the digestibility of the ration; hence, digestion, rather metabolism trials, were started with steers to determine the effect of molasses upon the digestibility of rations.

Three yearling steers were used for the metabolism trials. The rations were fed 14 days before beginning the collection of feces

and urine. The trial proper was of 10 days' duration, during which time records were made of feed consumption, weighback, feces, urine, and of gain or loss in weight. All chemical analyses were made by the department of Chemistry of the Louisiana Agricultural Experiment Station.

The rations fed during the first year are shown in table I.

Table I. Daily Rations Fed Digestion Steers, 1929-30

Trial	I	II	IV	V	VI
	pounds	pounds	pounds	pounds	pounds
Corn, ground whole ear	6.00	3.00	8.00	5.00	10.00
Molasses	-----	2.10	-----	2.09	2.09
Cottonseed meal	2.00	2.00	2.00	2.00	2.00
Hay	2.78	4.38	1.87	2.75	1.36
Silage	-----	-----	4.20	8.00	6.13
Total	10.78	11.48	16.07	19.84	21.58
Per cent molasses	0.	18.287	0.	9.634	9.88
Nutritive ratio	6.09	6.66	6.02	7.18	9.29

In setting up these trials an attempt was made to duplicate feed lot conditions, yet maintain a sound scientific proceduce. For example, when the steers were on trial II, they received the same rations as they had when they were on trial I, except that 2.10 pounds of molasses replaced an equivalent amount of corn grain (as ground whole ear corn). The steers consumed more hay during this trial. In trial IV corn-soybean silage was substituted for part of the hay. In trial V molasses was fed so as to replace an equivalent amount of corn grain as fed in trial IV. In trial VI the steers were allowed to consume all the ground whole ear corn, hay, and silage that they would, only the cottonseed meal and molasses being kept at a constant level.

From the feed consumed and the analyses of the feed and weighback, the percentage composition of the feed consumed was calculated. These calculated analyses are given in table II.

Table II. Calculated Chemical Composition of the Rations as Consumed by the Steers, 1929-30

Ration	Per cent molasses	Crude protein	Ether extract	Nitrogen free extract	Crude fiber	Ash
1	0	13.09	2.89	53.192	17.86	4.11
II	18.29	11.09	2.17	49.24	19.73	5.85
IV	0	9.96	1.76	42.28	12.98	2.95
V	9.63	7.70	2.05	39.09	11.57	3.34
VI	9.88	6.14	2.26	41.90	11.96	3.45

The digestion trial figures were subjected to statistical analysis (analysis of variance) and Snedecor's F values used to determine significance, an F value of 3.48 indicating significant variations and an F value of 5.99 indicating highly significant differences. The size of significant differences was then calculated. These figures are shown in table III.

Table III. Digestion Percentages of Rations, 1929-30.

Ration	Per cent molasses	Nutritive ratio	Crude protein	Ether extract	Nitrogen free extract	Crude fiber	Ash
I	0.	6.09	51.19	72.61	61.87	47.30	21.26
II	18.29	6.66	50.55	78.57	69.14	60.95	47.39
IV	0	6.02	53.34	63.10	59.68	48.16	13.66
V	9.63	7.18	39.83	83.68	61.69	37.33	27.96
VI	9.88	9.29	31.34	87.98	63.07	49.48	40.26
Snedecor F values			63.78	15.05	7.46	7.64	179.49
Significant differences			4.82	9.86	5.18	12.01	4.03
Highly significant differences			7.99	16.36	8.59	19.92	6.68

The F values all exceed 5.99, which means that highly significant variations occurred in the digestibility of all nutrients. An examination of table III shows which of these differences were significant. If these tests of significance are applied to each nutrient, the following conclusions appear justified:

Crude Protein—Adding either molasses or silage to a dry ration does not seem to affect the digestibility of the crude protein of the ration as a whole. Adding molasses to a ration containing silage lowers the digestibility of the crude protein, and this difference is highly significant.

Ether Extract—There was no significant difference in digestibility of the ether extract of rations I and II, showing that the addition of molasses to a dry ration did not affect the digestibility of the ether extract. Adding silage to corn, cottonseed meal, and hay resulted in a marked lowering of the digestibility of the ether extract; adding molasses increased its digestibility.

Nitrogen Free Extract—No significant differences existed in the digestibilities of nitrogen free extract of rations I, IV, V, and VI. The addition of 18.29 per cent molasses in ration II resulted in a significantly higher digestibility of the nitrogen free extract. The digestibilities of nitrogen free extract in rations V and VI were higher than in ration IV, indicating the tendency of molasses to increase the digestibility of N. F. E. These effects might result from the inclusion of molasses, inasmuch as the sugars in molasses are highly digestible; hence, an increase in the amount of molasses in a

ration would increase the digestibility of the total N. F. E. without necessarily affecting the digestibility of the N. F. E. of the other portions of the ration.

Crude Fiber—The digestibility of the crude fiber varied widely, and these variations were significant statistically, yet their interpretation is difficult. Adding molasses (18.29 per cent) to a dry ration increased the digestibility of crude fiber; adding molasses to a silage ration (rations IV and V) decreased the digestibility in ration V, but the digestibility of crude fiber in ration VI, which contained molasses, was not affected.

Ash—Ash digestibilities varied widely. Adding silage to a dry ration decreased the digestibility of ash; adding molasses increased the digestibility of ash.

RESULTS FOR 1930-31.

The second year, the plan of digestion trials was changed somewhat. A basal mixture containing eight parts ground whole ear corn, two parts cottonseed meal, and four parts chopped grass hay by weight was made. This basal mixture was used in trial I. In trials II, III, IV, and V, molasses replaced corn grain in the basal mixture in the following percentages: 15 per cent, 30 per cent, 45 per cent, and 100 per cent.

Three steers were used in each digestion trial. Each trial was preceded by a 14-day preliminary feeding period followed by a 10-day collection period.

The calculated chemical composition of the rations consumed is shown in table IV. These calculations were made from the weights and analysis of the feed fed and the feed refused.

TableIV. Calculated Chemical Composition of the Rations as Consumed by the Steers, 1930-31.

Ration	Per cent corn grain replaced by molasses	Crude protein	Ether extract	Nitrogen free extract	Crude fiber	Ash	Per cent molasses
I	0	13.75	3.80	50.40	14.70	4.55	0
II	15	11.98	3.13	56.55	12.18	5.56	13.04
III	30	9.54	2.62	55.59	11.23	7.45	23.08
IV	45	9.55	2.11	55.21	11.24	7.91	31.58
V	100	10.08	1.85	49.74	12.16	12.25	57.81

The only significant variation in the digestibility of the crude protein occurred in trial II, when the steers were fed a ration in which 15 per cent of the corn grain had been replaced by molasses. In this trial, average digestibility of crude protein was 66.45 per cent, which was from 11 to 18 per cent higher than the digestibilities of the crude protein in the rations fed during the other trials.

The average digestibilities of the feed nutrients are shown in table V.

Table V. Digestion Percentages of Rations, 1930-31.

Ration	Nutritive ratio	Per cent corn grain replaced by molasses	Per cent molasses	Crude protein	Ether extract	Nitrogen free extract	Crude fiber	Ash
I	5.56	0	0	55.54	79.00	63.05	28.71	37.69
II	5.77	15	13.04	66.45	78.16	67.97	17.27	55.06
III	8.29	30	23.08	48.69	77.89	72.79	32.19	63.81
IV	10.66	45	31.58	48.45	76.02	73.90	35.71	68.26
V	8.75	100	57.81	48.34	68.13	42.49	29.76	71.66
Snedecor's F values				6.48	1.19	4.91	1.67	33.15
Significant differences				12.14	none	8.67	none	9.26
Highly significant differences				20.13	none	14.38	none	15.35

The F values in Table V show significant variations to have occurred in the digestibilities of crude protein, nitrogen free extract, and ash.

The digestibilities of the N. F. E. increased, with the increase in amount of molasses incorporated in the ration up to the 45 per cent level. When all the corn grain was replaced by molasses, the average percentage of digestibility dropped abruptly from 73.9 per cent (ration IV) to 42.49 per cent (ration V). The reason for this drop is a matter for speculation.

The digestibilities of the ash increased, with the increase in molasses. Whether or not a more highly digestible ash was being fed with the molasses or whether the molasses increased the digestibility of the other ash is not known. The ash column in table IV, "Calculated Chemical Composition of Rations as Consumed by the Steers, 1930-31", indicates that the molasses contains an ash which is more highly digestible than the ash of the basal ration; hence, the digestibilities of the ash are higher.

NITROGEN AND ASH BALANCES

Nitrogen balances were determined in the year 1929-30, and both nitrogen and ash balances were determined during the year 1930-31. In order to make them comparable one with another and from year to year, these balances have been calculated to 1000 pounds live weight basis.

Because the amount of nitrogen or crude protein consumed may affect the amount retained, table VI is presented.

Table VI. Crude Protein Consumption and Morrison Standards, per 1000 pounds live weight, over 10-day digestion period

Trial	Per cent molasses	Crude protein consumed, lbs.	Crude protein required by Morrison standards, lbs.	Average excess, lbs.
I	0	36.081	24.5	12.58
II	18.29	29.163	22	7.16
IV	0	36.156	22	14.16
V	9.63	33.369	22	11.37
VI	9.88	23.044	21	2.04

Table VI shows the amounts of crude protein fed in each trial to be greater than that required by the Morrison Standards; hence, some storage of crude protein might be expected. Table VII shows the nitrogen balances calculated to 1000 pounds for each digestion trial.

TableVII. Average Nitrogen Balances Calculated on the Basis of 1000 Pounds Live Weight, 1929-30.

Trial	Ration	Per cent molasses	Ten-day nitrogen average	
			Consumption, pounds	Balance, pounds
I	Dry	0	5.7732	1.4937
II	Dry	18.29	4.8660	1.7334
IV	Silage	0	5.7849	1.2668
V	Silage	9.63	5.3387	0.9036
VI	Silage	9.88	3.6874	0.1391

Average difference in N balance to be significant—0.336 pounds.
Average difference in N balance to be highly significant—0.557 pounds.

This table shows no significant difference in the storage of nitrogen during trials I and II in which no silage was fed. The inclusion of 18.29 per cent of molasses to a dry ration did not affect significantly the storage of nitrogen. A comparison of the balances of trials I and IV shows that the storage of nitrogen from the silage ration (trial IV) did not differ significantly from that of the dry ration (trial I). However, the addition of molasses to a silage ration, as fed in trials V and VI, resulted in a significant lowering of the nitrogen balances. Hence, it seems as though the protein of the molasses-silage rations was not utilized as efficiently as that of the dry ration, the dry ration plus molasses, or the silage ration.

The average nitrogen and ash balances for 1930-31 are shown in table VIII.

No significant differences occurred in the nitrogen balances or in the storage of nitrogen from the dry rations and dry ration plus molasses in the year 1929-30. Hence, these figures are in line.

The ash balances increased as the percentage of molasses in the dry ration increased. The storage of calcium and magnesium also increased with an increase of molasses in the ration, which raised the consumption of these two elements. Hence, this may have affected the retention of the two elements. Not only were the balances increased with the increase of molasses in the ration, but also the percentage of these elements retained in the body was significantly affected. These figures are shown in table IX.

Significant variations occurred in percentages retained of nitrogen, ash, calcium oxide, and magnesium oxide. No significant differences occurred in the percentage of phosphorus pentoxide retained.

The figures on percentage nitrogen retained might be construed to mean that the replacement of 15 per cent of the corn by a similar amount of molasses favored nitrogen retention and that the inclusion

Table VIII. Average Nitrogen and Ash Balances Calculated on Basis of 1000 Pounds Live Weight, 1930-31.

Trial	Per cent Molasses	Nitrogen		Ash		P_2O_5		CaO		MgO	
		Consumed	Balance	Consumed	Balance	Consumed	Balance	Consumed	Balance	Consumed	Balance
I	0	6.904	1.569	14.237	2.894	3.434	1.021	1.038	0.327	1.038	0.339
II	13.04	5.849	1.853	16.958	5.546	2.976	1.197	1.528	0.933	1.134	0.429
III	23.08	4.807	1.164	23.465	8.413	2.884	0.904	2.160	1.580	1.464	0.886
IV	31.58	4.698	1.092	24.341	8.897	2.442	1.018	2.390	1.907	1.489	0.849
V	57.81	5.002	0.819	38.278	14.682	2.068	0.197	3.779	2.649	2.241	1.305
Snedecor's F values*		2.59		10.397		1.89		8.93		4.64	
Significant difference		none		5.323		none		1.189		2.245	
Highly significant difference		none		8.828		none		1.972		3.723	

F values* to denote significant variation must be 3.48 or more.

Table IX. Consumption and Retention of Nitrogen and Ash by Percentages, Calculated on Basis of 1000 pounds Live Weight, 1930-31.

Trial	Per cent Molasses	Nitrogen		Ash		P_2O_5		CaO		MgO	
		Consumed	Per cent retained	Consumed	Per cent retained	Consumed	Per cent retained	Consumed	Per cent retained	Consumed	Per cent retained
I	0	6.904	22.62	14.237	20.39	3.434	28.75	1.0383	29.65	1.038	32.12
II	13.04	5.849	31.53	16.958	32.13	2.976	39.07	1.528	60.70	1.134	38.15
III	23.08	4.807	21.92	23.465	36.15	2.884	31.78	2.160	73.05	1.464	72.56
IV	31.58	4.698	23.49	24.341	36.89	2.442	40.57	2.390	79.69	1.489	56.61
V	57.81	5.002	16.46	38.278	38.80	2.068	10.62	3.779	70.14	2.241	58.16
Snedecor's F values			9.84		3.84		2.66		40.02		7.76
Significant difference			6.58		15.27		none		12.21		19.52
Highly significant differences			10.91		25.33		none		20.25		32.42

of greater amounts of molasses had the opposite effect. However, the data are too few to draw conclusions.

Table X gives additional data on this point.

Table X. Crude Protein Consumption and Morrison Standards, per 1000 Pounds Live Weight—Over 10-Day Digestion Period

Trial	Per cent Molasses	Crude Protein Consumed Pounds	Crude Protein Required by Morrison's Standards Pounds	Excess Pounds	Per cent Retained
I	0	43.15	24.5	18.65	22.62
II	13.04	36.56	23.6	12.96	31.53
III	23.08	30.08	22.83	7.25	21.92
IV	31.58	29.35	22.83	6.52	23.49
V	57.81	31.26	21.3	9.96	16.46

The percentage of ash retained increased with the amount of molasses in the feed. Likewise the percentage calcium oxide increased with the increase in molasses in the ration except in ration V, in which instance all the corn was replaced by molasses. Whether molasses increased the ash and calcium retention or whether their retention was due to the fact that molasses increased the amount of ash and calcium oxide in the ration cannot be ascertained from the date. However, the latter seems more plausible, and the author is inclined to think that these steers did not ordinarily obtain the optimum amount of ash and calcium in their rations.

PART II

BLACKSTRAP MOLASSES AND CORN-SOYBEAN SILAGE FOR FATTENING YEARLING STEERS

Just when molasses was first fed to Louisiana livestock is not known. However, the use of molasses as a feed for livestock in Louisiana is probably as old as the industry in this state.

As the review of literature indicates, the value of molasses as a feed for cattle varies with the amount of molasses fed and the other feeds given with it. Rations ordinarily fed in the South include corn, cottonseed meal, hay, and silage. In order to get additional information on the value of molasses when fed with the above mentioned feeds, a two-year steer feeding experiment was started in 1929. These feeding trials covered 140 and 150 days, respectively. The rations fed are as follows:

Lot I. Ground whole ear corn, cottonseed meal, and hay.

Lot II. Ground whole ear corn, molasses, cottonseed meal, and hay.

Lot III. Ground whole ear corn, cottonseed meal, hay, and corn-soybean silage.

Lot IV. Ground whole ear corn, molasses, cottonseed meal, hay, and corn-soybean silage.

The ground whole ear corn as fed in this experiment included corn, cob, and shuck, and averaged 76 per cent grain. The molasses of lots II and IV was fed so as to replace an equivalent amount of corn grain in lots I and III. The ground whole ear corn and cottonseed meal were placed in the feed bunks and the molasses poured over the mixture. In lots III and IV, the silage was put in the feed bunks on top of the grain. The hay was fed in self-feeder racks in all lots.

First Feeding Trial—1929-30

The results of the first feeding trial are summarized in table VI, "Summary of Results of 140-Day Steer Feeding Trial, 1929-30".

The lot IV yearlings getting ground whole ear corn, molasses, cottonseed meal hay, and silage made the most rapid and the cheapest gains of any of the lots. Their average daily gain was 2.16 pounds per head, and the cost for each 100 pounds of gain was $9.65. The daily gains of the other lots were: lot I, 2.07 pounds; lot II, 2.01 pounds, and lot III, 2.12 pounds. The cost for 100 pounds of gain was: lot I, $10.23; lot II, $9.86, and lot III, $10.44.

Lot I demonstrated that satisfactory gains can be made with rations of ground whole ear corn, cottonseed meal, and mixed grass hay.

The feeding of 2.38 pounds of molasses in place of corn grain in lot II resulted in a decrease in average daily gain, but increased the hay consumption and the feed required for the 100 pounds of gain. One hundred and forty-one pounds of ground whole ear corn as fed in the lot I ration were equivalent to 118 pounds of molasses, 3 pounds of cottonseed meal, and 77 pounds of hay. On this basis molasses was worth 14.84 cents per gallon, or $25.20 per ton.

The addition in lot IV of 2.38 pounds of molasses in place of an equivalent amount of corn resulted in increasing the rate of gain and in an increase in the hay consumption as compared with lot III. In this case, 152 pounds of ground whole ear corn and two pounds of cottonseed meal as fed in lot III were equivalent to 110 pounds of molasses, 12 pounds of hay, and 302 pounds of silage in the lot IV ration. On this basis, blackstrap molasses was worth 14.13 cents a gallon, or $24.15 a ton.

A comparison of lots I and III shows the effect of adding corn and soybean silage to a ration of ground whole ear corn, cottonseed meal, and hay. The lot III steers made an average daily gain of

TABLE VI.

SUMMARY OF RESULTS OF STEER FEEDING TRIAL, 1929-30

10 Steers per lot fed October 25, 1929, to March 15, 1930—140 Days

TABLE BASED ON ONE AVERAGE STEER

LOT	I	II	III	IV
Rations Fed Flake Salt in All Lots	Gr. Whole Ear Corn, C. S. Meal Hay	Gr. Whole Ear Corn, C. S. Meal Molasses, Hay	Gr. Whole Ear Corn, C. S. Meal Silage, Hay	Gr. Whole Ear Corn, Molasses C. S. Meal, Hay Silage
Initial weight, lbs.	428	431	430	426
Final weight, lbs.	718	712	727	728
Daily gain, lbs.	2.07	2.01	2.12	2.16
Daily feed, lbs.				
Gr. whole ear corn	9.26	6.14	9.30	6.15
Molasses	------	2.38	------	2.38
C. S. Meal	2.07	2.07	2.08	2.08
Hay	7.09	8.31	4.80	5.13
Silage	------	------	8.30	10.73
Feed required for 100 lbs. gain				
Gr. whole ear corn	447	306	438	286
Molasses	------	118	------	110
C. S. Meal	100	103	98	96
Hay	337	414	226	238
Silage	------	------	391	498
Feed cost per 100 lbs. gain	$10.23	$ 9.86	$10.44	$ 9.65
Cost per steer @ 3c per lb.	12.74	12.93	12.90	12.78
Feed cost per steer	29.65	27.70	31.01	29.12
Estimated fixed costs	1.70	1.70	1.70	1.70
Labor costs	1.50	1.50	1.50	1.50
Total estimated costs	$45.59	$43.83	$47.11	$45.10
Necessary selling price per cwt. to break even at Baton Rouge	$ 6.35	$ 6.15	$ 6.48	$ 6.20
Prices of feed:				
Gr. whole ear corn	$1.4260 per cwt.		$ 1.08	per bushel
Molasses	1.00	per cwt.	.117	per gallon
Cottonseed meal	2.00	per cwt.	40.00	per ton
Mixed hay	.60	per cwt.	12.00	per ton
Soybean hay	.60	per cwt.	12.00	per ton
Salt	1.00	per cwt.		
Grass hay	.50	per cwt.	10.00	per ton
Mineral mixture	2.00	per cwt.		
Silage	.25	per cwt.	5.00	per ton

TABLE VII

SUMMARY OF RESULTS OF STEER FEEDING TRIAL, 1930-31

October 15, 1930, to March 14, 1931—150 Days

10 Steers per Lot

TABLE BASED ON THE AVERAGE STEER

LOT	I	II	III	IV
Rations fed Block Salt in All Lots Mineral Mixture in All Lots	Gr. Whole Ear Corn, C. S. Meal Hay	Gr. Whole Ear Corn, C. S. Meal Molasses, Hay	Gr. Whole Ear Corn, Silage C. S. Meal, Hay	Gr. Whole Ear Corn, Molasses, C. S. Meal, Hay Silage
Initial weight, lbs.	380.	383.	378.	371.
Final weight, lbs.	658.	662.	643.	642.
Daily gain, lbs.	1.85	1.86	1.77	1.81
Daily feed, lbs.				
Corn, ground whole ear	11.90	9.21	11.14	9.21
Molasses	------	1.98	------	1.95
Cottonseed meal	2.02	2.02	2.02	2.01
Hay, grass	2.10	3.43	1.42	2.79
Silage	------	------	1.30	1.65
Feed required per 100 lbs'. gain				
Corn, ground whole ear	642	495	631	512
Molasses	------	106	------	108
Cottonseed meal	109	109	115	112
Hay, grass	113	184	80	155
Silage	------	------	73	91
Feed cost per 100 lbs. gain	$11.96	$11.28	$11.92	$11.65
Cost per steer @ 3c per lb.	11.40	11.48	11.34	11.12
Feed cost per steer	33.27	31.47	31.57	31.46
Estimated fixed costs	1.70	1.70	1.70	1.70
Labor costs	1.50	1.50	1.50	1.50
Total estimated costs	$47.87	$46.15	$46.11	$45.78
Necessary home price to break even at Baton Rouge	$ 7.26	$ 6.97	$ 7.16	$ 7.13
Prices of Feeds:				
Ground whole ear corn	$1.4260 per cwt.		$ 1.08	per bushel
Molasses	1.00	per cwt.	.117	per gallon
Cottonseed meal	2.00	per cwt.	40.00	per ton
Silage	.25	per cwt.	5.00	per ton
Grass hay	.50	per cwt.	12.00	per ton
Salt	1.00	per cwt.	20.00	per ton
Mineral mixture	2.00	per cwt.	40.00	per ton
Mixed hay	.60	per cwt.	12.00	per ton
Soybean hay	.60	per cwt.	12.00	per ton

2.16 pounds as compared with 2.07 pounds daily for the lot I steers. Silage as fed in this trial and with feed values as given had a replacement value of $4.27 a ton.

A comparison of lots II and IV shows the effect of adding silage to a ration of ground whole ear corn, molasses, cottonseed meal, and hay. The addition of silage increased the rate of gain and decreased the feed cost per 100 pounds' gain. Under these conditions, silage had a replacement value of $6.27.

Second Feeding Trial—1930-31

The results of the second feeding trial are shown in table VII, "Summary of Results of Steer Feeding Trial, 1930-31".

Again satisfactory gains were made with a ration of ground whole ear corn, cottonseed meal, and grass hay.

The replacing of two pounds of corn grain by blackstrap molasses as fed in lot II resulted in a slight increase in gain, but also in an increase in hay consumption.

The addition of corn-soybean silage to the ground whole ear corn—cottonseed meal—hay ration as fed in lot III resulted in a decrease in the rate of gain. The silage fed this year was not of the best quality, and the consumption was low, which may have caused the lowered gains.

The addition of molasses to the silage ration, when fed as in lot IV, resulted in increased gains and feed consumption.

Molasses is apparently an appetizing feed. The steers in lots II and IV receiving two pounds of molasses daily cleaned their troughs daily, while the steers in lots I and II were inclined to leave feed in their troughs. The hay consumption in lot II was greater than in lot I; the steers in lot IV ate more hay and more silage and had less feed left in their troughs than did the steers in lot III.

The increased gains of lots II and IV over lots I and III, respectively, were probably due to increased feed consumption.

One hundred pounds of ground whole ear corn plus 2.22 pounds of cottonseed meal as fed in lot I were equivalent to 73 pounds of blackstrap molasses and 71 pounds of grass hay as fed in lot II. On this basis, blackstrap molasses was worth 16.74 cents per gallon, or $28.61 per ton.

When lots III and IV are compared, 100 pounds of ground whole ear corn plus 2.7 pounds of cottonseed meal have an equivalent feeding value of 89 pounds molasses, 61 pounds of hay, and 15 pounds of silage. Under these conditions, molasses has a value of 14.15 cents per gallon, or $24.19 per ton.

BIBLIOGRAPHY

Bohstedt, G.; Roche, B. H.; Fargo, J. M.; Rupel, I. W.; Fuller, J. G., and Newman, Paul E., 1933. Molasses incorporated in grain mixtures. American Society of Animal Production, record of proceedings of the twenty-sixth annual meeting.

Brintnall, Earl. 1921.
Blackstrap molasses for dairy cows. Mississippi Agr. Exp. Sta. Circ., No. 38.

Bourg, C. J. 1935.
Processing tax on invert syrups. The Sugar Bulletin, Vol. 13, No. 10, p. 3.

Culbertson, C. C.; Evvard, John M.; Hammond, W. E., and Bassett, C. F. 1929.
Cane molasses for finishing calves. Iowa Agr. Exp. Sta. Leaflet No. 27. Animal Husbandry Section.

Dalrymple, W. H. 1906.
Louisiana Exp. Sta. Bul. 86.

Edwards, F. R., and Massey, Z. A. 1934.
Beef cattle production in Georgia. Ga. Sta. Bul. 184.

Evvard, John M., and Culbertson, C. C. 1921.
Cane versus beet molasses for fattening two-year old steers. Proc. Am. Soc. An. Prod., 1920. p. 62.

Evvard, John M.; Culbertson, C. C., and Wallace, Quinten W. 1923.
Cane and beet molasses for fattening lambs. Iowa Agr. Exp. Sta. Bul. 215.

Gerlaugh, Paul. 1930.
Molasses in rations for fattening calves. Ohio Agr. Exp. Sta. Bul. 463.

Henry, W. A., and Morrison, F. B. 1922.
Feeds and feeding. Henry-Morrison Co., Madison, Wisconsin. p. 189-479.

Lantow, J. L.
Steer fattening rations built largely around ground corn fodder and silage with cottonseed meal and molasses as the added concentrates. New Mexico Agr. Exp. Sta. Bul. No. 211.

McCampbell, C. W., and Winchester, H. B. 1920.
Cattle feeding investigations, 1919-1920. Kansas Exp. Sta. Circ., 86.

Neale, P. E. 1932.
The use of cottonseed meal, cottonseed hulls, and molasses in fattening rations for New Mexico range lambs. N. M. Agr. Exp. Sta. Bul. 200.

Nelson, V. E.; Keller, V. G., and Fulmer, E. 1925.

Molasses as a source of vitamin B. Ind. and Eng. Chem., Vol. 17, p. 199. Feb., 1925.

Peters, W. H. 1933.
Selection and purchase of feeders and rations for fattening beef cattle. Minn. Agr. Exp. Sta. Bul. 300.

Quesenberry, J. R. 1929.
Steer feeding experiments in the sugarcane belt. U. S. D. A. Circ., No. 65.

Sheets, E. W. 1928.
Letter to Dr. C. I. Bray.

Skinner, J. H., and King, F. G. 1916.
Fattening western lambs. Indiana Agr. Exp. Sta. Bul. 192.

Snedecor, George W. 1934.
Calculation and interpretation of analysis of variance and covariance. Collegiate Press, Inc., Ames, Iowa. pp. 15 and 88.

Snell, M. G., and Taggart, W. G. 1932.
Blackstrap molasses for farm work mules. Louisiana Bulletin No. 230.

Templeton, G. S. 1925.
Mississippi Agr. Exp. Station. Annual Report, 1925.

Templeton, George S., and Goodell, C. J. 1927.
Steer feeding experiments and actuary. Mississippi Agr. Exp. Sta. Bul. 242.

Trowbridge, E. A. 1924.
The use of a limited amount of molasses in fattening yearling steers. Missouri Sta. Bul. 223. Reported in Exp. Sta. Record, Vol. 53. p. 406.

Williams, P. S. 1925.
The effect of cane molasses on the digestibility of a complete ration fed to dairy cows.
Journal of Dairy Science, 8(1925) No. 2, p. 94-104. Reported in Exp. Sta. Record, Vol. 54. p. 67.

PIKE BURDEN, INC.